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DYNAMIC END OF REFILL DETECTION BASED ON INK PRESSURE PROFILE

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Dynamic End of Refill detection based on ink pressure profile

The detection of the End of Refill (EOR) event of an Intermediate Tank (IT) is based on monitoring the ink pressure using a pressure transductor. When the ink pressure reaches a certain threshold, the IT is detected as full and the ink pump is stopped.

In some printers, the ink pressure is monitored by using a pressure sensor based on the Hall effect principle. When there is a pressure difference between the ink channel and the air channel, the electromagnetic field is altered.

Ink Delivery System algorithms relies on an ink pressure sensor with a well-known calibration. However, sensor calibration may be altered by heat, moisture and time, affecting on the magnetization of the magnet and directly affecting to the ink pressure readings. If the calibration is altered, it could lead to an Ink Delivery System malfunction, such as detecting the IT as full before it is full, or over-pressurizing the IT if the End of Refill is not properly detected.

Note: see the following schematics of an Ink Delivery System with an Intermediate Tank as reference.
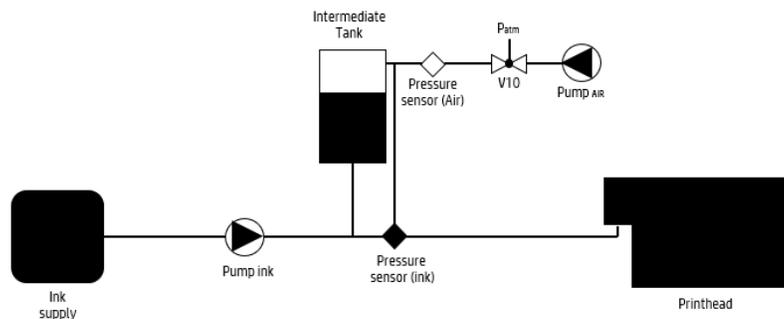
This invention describes a process to detect the End of Refill event based on the ink pressure profile, rather than reaching a certain ink pressure threshold, not dependence on the pressure sensor calibration.
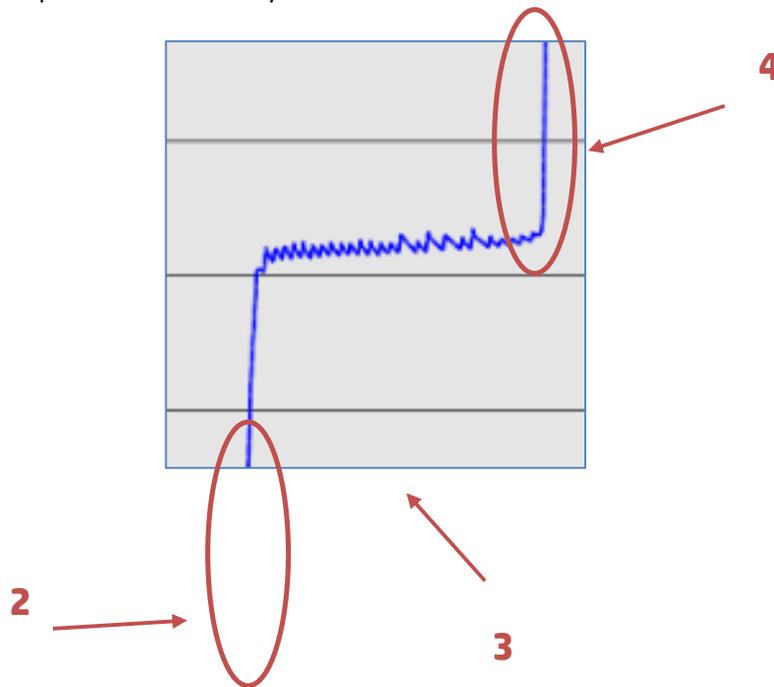
When the IT is being refilled, the ink pressure increases linearly with the IT level, but when the IT is almost full, the ink pressure profile increases exponentially, due to the interaction between the ink bag and the IT walls.

The solution to detect the EOR is based on monitoring the ink pressure profile, when the slope of the ink pressure reaches a certain threshold, related to the interaction between the ink bag and the walls, the IT is detected as full.

During the refill of the IT, there ink pressure describes a characteristic profile:

1. When the ink bag is totally empty, the air pressure is not transmitted to the ink, due to that the ink pressure is low.
2. When the IT is being refilled and the air pressure is transmitted to the bag, the ink pressure profiles describes a suddenly increasement.

3. After that, the ink pressure increases linearly with the IT ink level.
4. Finally, when the IT is full and the bag interacts with the IT wall, the ink pressure experiments a suddenly increasement.

The Dynamic End of Refill detection algorithm monitors the ink pressure profile. When the ink pressure slope reaches a certain threshold, the IT is detected as full, rather than detecting the EOR event based on reaching a certain ink pressure threshold that may be affected by temperature, moisture and time due to the demagnetization of the magnet.

The advantages that provide the Dynamic End of Refill algorithm are:

- **Robustness**: the EOR algorithm does not rely on reaching a certain pressure, which can vary with a lot of variables like supply height or drop pressures of the system, detecting the EOR based on a well characterized ink pressure profile.
- **Printer location**: as the EOR algorithm is much less impacted by the temperature and the moisture, the ink pressure sensor could be located at any part of the printer, even though close to warm locations. Also, it implies that the printer can work on a wider range of room temperature and humidity.
- **Magnet demagnetization**: the EOR algorithm is less much affected by the demagnetization of the magnets of the pressure sensor. A typical error of this sensor is having demagnetization of the sensor (due to moisture, temperature, …) that avoids reaching this end of refill condition leaving the printer inoperative.
- **Repair cost**: issues related to overpressures that may lead to broken bags of the IT or ink leakage through the fittings are avoided, avoiding reparations.
- **Customer experience**: supplies are not falsely marked as depleted when there is still ink on the supply.
- **Flexible solution**: the solution does not depend on the ink type and cartridges types and can be adapted to different IT geometries.

- **Cost**: It reuses the current hardware of the printer and no additional electronic element (EE board, cables, …) or mechanical parts are required.

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